REMARKS/ARGUMENTS

Reexamination of the captioned application is respectfully requested.

A. SUMMARY OF THIS AMENDMENT

By the current amendment, Applicants basically:

1. Amend independent claims 1, 13 and 19 (see section B infra), as well as dependent claims 4, 7, 9 – 10, 14, 16 – 18, 20, and 22 – 23 for consistency therewith.
2. Cancel claims 12 and 21 without prejudice or disclaimer.
3. Respectfully traverse all prior art rejections.
4. Advise the Examiner of the simultaneous filing of a Petition to Extend.

B. AMENDMENTS TO THE INDEPENDENT CLAIMS

Independent claims 1, 13, and 19 have been amended so that the insulating film is now more fully described as a low dielectric constant insulating film. Support for the amendment is found, e.g., in extant dependent claim 9.

Independent claims 1, 13, and 19 have also been amended so that what was formerly referred to as the "oxygen-containing gas" is now "substantially pure oxygen gas". Support for the amendment resides, e.g., in page 7, line 7, of the specification, which refers to "almost pure oxygen gas".

C. PATENTABILITY OF THE CLAIMS

Claims 1-4, 7-14 and 16-23 stand under 35 USC 102(e) as being anticipated by U.S. Publication 2003/0162407 to Maex et al. Claim 19 stands rejected under 35 USC 102(b) as being anticipated by U.S. Patent 6,440,864 to Kropewnicki et al. Claims 1-4, 7-14 and 16-23 stand under 35 USC 103(a) as being unpatentable over U.S. Patent

6,440,864 to Kropewnicki et al in view of U.S. Patent 5,453,157 to Jeng. All prior art rejections are respectfully traversed for at least the following reasons.

The claimed method removes a resist film formed on a low dielectric constant insulating film by ashing using an almost pure oxygen gas. One of the characteristics of the Applicant's independent claims is that the ratio of Ws/Wb is set to a specific range at the time of removal.

The FT-IR waveform of Applicant's low dielectric constant insulating film before/after the ashing under the conditions is shown in Fig. 2. Fig. 2 contrasts conditions of Applicant's claim with conditions of Fig. 4 and Fig. 6, as described below.

Fig. 4 is a waveform of the insulating film when ashing is performed without applying RF electric power to the substrate side. In Fig. 4, a peak showing that H-OH bonds are formed after the ashing appears near 3500 Å (see page 11, line 16-page 12, line 4 of the specification). The H-OH bonds increase the dielectric constant (see page 11, line 24-page 12, line 4 of the specification).

Fig. 6 is a waveform of the insulating film when conventional ashing is performed. In Fig. 6, a peak showing that O-OH bonds are formed after the ashing appears near 3500Å as in the case of Fig. 4 (see page 12, line 5-page 13, line 6).

Thus, in both Figs 4 and 6, the amount of C-H bonds, Si-H bonds and Si-C bonds is reduced. A decrease in the amount of these bonds increases the dielectric constant (see page 12, line 21-page 13, line 6 of the specification).

Applicant's Fig. 2, on the other hand, is a waveform of the insulating film when ashing is performed with RF electric power applied to the substrate side. In Fig. 2, a peak showing that H-OH bonds are formed after the ashing does not exist. Furthermore, the

amount of C-H bonds, Si-H bonds and Si-C bonds does not change. Therefore, it is apparent that a change in dielectric constant is extremely small when ashing is performed under Applicants' claimed conditions.

Fig. A attached hereto is a graph illustrating a relationship between the RF electric power on the substrate side and the amount of H-OH bonds and Si-OH bonds. The vertical axis shows the rate of H-OH and Si-OH bonds increase before/after ashing. From Fig. A it is apparent that the Ws/Wb relates to the decrease in the amount of H-OH bonds which increase the dielectric constant.

It is thought that this claimed decrease in the amount of H-OH bonds is because the SiO film formed on the surface of the low dielectric constant insulating film at the ashing serves as a protective film for preventing oxygen from being contained in the insulating film (see page 10, lines 17-22 of the specification). This belief is supported by, for example, Figs. B and C which are also attached hereto.

Figs. B and C are graphs showing changes in atomic ratio of O, Si and C in the substrate depth direction when the RF electric power applied to the substrate side are O Watts and 450 Watts (which is included in the claimed invention), respectively. In Fig. B and Fig. C, the far-left of the lateral axis indicates the surface of the low dielectric constant insulating film and the area thicker than about 2300Å indicates the Si substrate. The atomic ratio at 0 Watts is changing even near 1000 Å in Fig. B, whereas it does not change in an area any deeper than near 200Å in Fig. C.

From Fig. C, it is apparent that the Ws/Wb within a specific range allows the protective film made of the SiO film, to be formed on the surface of the low dielectric constant insulating film. This protective film prevents Oxygen from reaching inside the insulating film. Therefore, it is found that a change in dielectric constant of the insulating film before/after the ashing is little.

Unlike Applicant's claims, Maex does not teach the use of an almost pure oxygen gas when removing the resist mask formed on the low dielectric constant insulating film by ashing.

The ashing gas used in Paragraph [0078] of Maex indicated by the Examiner is used with an oxygen-containing gas and inert gas, and Maex has no description on the use of the almost pure oxygen gas as the ashing gas.

When an oxygen gas is used as the ashing gas, the amount of C-H bonds, Si-H bonds and Si-C bonds usually decreases and the amount of H-OH bonds and Si-OH bonds usually increases in the low dielectric constant insulating film. Applicant discovered, and now claims, that setting the ratio of Ws/Wb in a specific range allows the amount of these bonds not to change even when the almost pure oxygen gas is used as the ashing gas. Such a technical idea is not at all described in Maex.

In addition to the above, since Maex's ashing gas contains an inert gas, it is assumed that Maex has a smaller change in the amount of C-H bonds, Si-H bonds, Si-C bonds, H-OH bonds and Si-OH bonds than the claimed invention which uses the almost pure oxygen gas.

Neither Kropewnicki nor Jeng teaches the ashing method of the claimed invention in which the ratio of Ws/Wb is set to 5 or smaller, and therefore, neither reference provides a basis for denying patentability to Applicant's claims.

D. MISCELLANEOUS

In view of the foregoing and other considerations, all claims are deemed in condition for allowance. A formal indication of allowability is earnestly solicited.

NISHIDA
Appl. No. 09/986,987
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The Commissioner is authorized to charge the undersigned's deposit account #14-1140 in whatever amount is necessary for entry of these papers and the continued pendency of the captioned application.

Should the Examiner feel that an interview with the undersigned would facilitate allowance of this application, the Examiner is encouraged to contact the undersigned.

Respectfully submitted,

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